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PATENT  
Docket No. LC-499/US

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re: Application of:

John G. Woods, et al. Confirm No.: 2111  
Appl. No.: 10/692,935 Examiner: R. E. Sellers  
Filed: 10/27/2003 Art Unit: 1712  
Title: NOVEL TOUGHENING AGENTS, COMPOSITIONS  
BASED THEREON AND METHODS FOR THE USE THEREOF

CERTIFICATE OF MAILING

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*Mary Lynne Carlisle*

Signature of certifier

Mary Lynne Carlisle

Typed or printed name of certifier

APPEAL BRIEF TRANSMITTAL

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Respectfully submitted,

*Stephen D. Harper*

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Enclosures

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LC-499/US  
PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE  
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re Application of: :  
John G. Woods, et al : ) Examiner: R. E. Sellers  
Application No.: 10/692,935 : ) Group Art Unit: 1712  
Filed: October 27, 2003 : ) Confirmation No.: 2111  
For: NOVEL TOUGHENING AGENTS, :  
COMPOSITIONS BASED : )  
THEREON AND METHODS FOR :  
THE USE THEREOF : )

CERTIFICATE OF MAILING

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APPEAL BRIEF

Mail Stop Appeal Brief-Patents  
Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

Sir:

Submitted herewith is an Appeal Brief for the  
above-referenced application, pursuant to the Notice of  
Appeal submitted June 12, 2006.

Application No. 10/692,935  
Art Unit: 1712

**TABLE OF CONTENTS**

	<u>Page</u>
REAL PARTY IN INTEREST	3
RELATED APPEALS AND INTERFERENCES	4
STATUS OF CLAIMS	5
SUMMARY OF CLAIMED SUBJECT MATTER	6
GROUND OF REJECTION TO BE REVIEWED ON APPEAL	8
ARGUMENT	9
CLAIMS APPENDIX	16
EVIDENCE APPENDIX	26
RELATED PROCEEDINGS APPENDIX	27

Application No. 10/692,935

Art Unit: 1712

**REAL PARTY IN INTEREST**

The real party in interest is Henkel Corporation, having a place of business at 2200 Renaissance Boulevard, Suite 200, Gulph Mills, Pennsylvania 19406.

Application No. 10/692,935  
Art Unit: 1712

**RELATED APPEALS AND INTERFERENCES**

Appellants are not aware of any prior or pending appeal, judicial proceeding or interference which may be related to, directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

Application No. 10/692,935  
Art Unit: 1712

**STATUS OF CLAIMS**

Claims 1-18 and 23-33 have been withdrawn. All of the remaining claims (Claims 19-22 and 34) are on appeal.

**SUMMARY OF CLAIMED SUBJECT MATTER**

The present invention as defined by independent Claim 19 is directed to a method to improve the fracture toughness of a curable epoxy-based adhesive composition.

The method includes the steps of adding to the adhesive composition an effective amount of a toughening agent comprising a curable epoxy-extended polyacrylate having at least one  $\beta$ -hydroxyester linkage. The polyacrylate from which the epoxy-extended polyacrylate is derived has a number average molecular weight in the range of about 1000 up to about 10,000, an average functionality of at least about 2.2, and the functionality of the polyacrylate from which the epoxy-extended polyacrylate is derived is a carboxylic acid. The subject matter defined in independent claim 19 is described in the following sections of the specification: Paragraph 0001, lines 4-5; Paragraph 0017, lines 2-5; Paragraph 0020, lines 1-3; and Paragraph 0083, lines 3-5.

As defined by independent Claim 20, the invention is also directed to a curable adhesive formulation comprising a curable epoxy resin, a curing agent, and at least one toughening agent comprising a curable epoxy-extended polyacrylate having at least one  $\beta$ -hydroxyester

Application No. 10/692,935  
Art Unit: 1712

linkage. The polyacrylate from which the epoxy-extended polyacrylate is derived has a number average molecular weight in the range of about 1000 up to about 10,000, an average functionality of at least about 2.2, and the functionality of the polyacrylate from which the epoxy-extended polyacrylate is derived is a carboxylic acid. Optionally, the composition includes a filler. The subject matter defined in independent claim 20 is described in the following sections of the specification: Paragraph 0001, lines 2-4; Paragraph 0017, lines 2-5; Paragraph 0020, lines 1-3; Paragraph 43, lines 1-6; and Paragraph 0083, lines 3-5.

Application No. 10/692,935  
Art Unit: 1712

**GROUND OF REJECTION TO BE REVIEWED ON APPEAL**

1. Whether Claims 19-22 and 34 are unpatentable under 35 U.S.C. Section 102(b) over Fock et al. (U.S. Pat. No. 4,460,746).
2. Whether Claims 19-22 and 34 are unpatentable under 35 U.S.C. Section 103(a) over Fock et al. (U.S. Pat. No. 4,460,746).

**ARGUMENT**

1. Rejection of Claims 19-22 and 34 as unpatentable under 35 U.S.C. Section 102(b) over Fock et al. (U.S. Pat. No. 4,460,746)

Fock is directed to and claims a method for flexibilizing epoxide resins comprising adding to the epoxide resins, prior to curing, copolymers obtained by the polymerization of a<sub>1</sub>) 40 to 87 weight percent of one or more alkyl esters of acrylic or methacrylic acid having 1 to 8 carbon atoms in the alkyl radical, a<sub>2</sub>) 10 to 40 weight percent of vinyl acetate or acrylonitrile, a<sub>3</sub>) 1 to 20 weight percent of acrylic, methacrylic or itaconic acid, a<sub>4</sub>) 1 to 5 weight percent of glycidyl acrylate or glycidyl methacrylate, and a<sub>5</sub>) 0 to 35 weight percent of acrylic or vinyl monomers which are different from the monomers a<sub>1</sub> to a<sub>4</sub>, in the presence of a regulator, which contains mercapto groups and has at least one carboxyl group, where the copolymers having an average molecular weight of 1,000 to 3,000, as measured in a vapor pressure osmometer, in amounts such that 1 to 60 mole percent of the epoxide groups of the epoxide resins react with the carboxyl groups of the copolymer.

The use of vinyl acetate or acrylonitrile as monomers creates a polymer that does not flow and is unsuitable for capillary flow underfill applications.

As can be seen from the manner by which the inventive epoxy-extended polyacrylates are made, the inventive polyacrylates are not the copolymers described by Fock. More specifically, Fock requires a copolymer made from alkyl esters of acrylic or methacrylic acid, vinyl acetate or acrylonitrile, glycidyl acrylate or glycidyl methacrylate, and acrylic or vinyl monomers. Appellants' epoxy-extended polyacrylates are not so defined.

The copolymers taught by Fock cannot be used to improve the fracture toughness of adhesive compositions.

That is, the copolymers described in the Fock reference are used as flexibilizers, which will render the cured product obtained by curing a formulation containing the flexibilizer more peel resistant. In contrast, the toughening agents utilized in Appellants' invention improve fracture toughness in epoxy-based compositions, which may or may not affect the peel resistance. However, the copolymers of the Fock reference would not improve fracture toughness.

The Fock reference, as noted above, is directed to flexibilizing, which often does not correlate with

toughness. Peel strength increases with increased flexibility; fracture toughness does not necessarily improve when flexibility is increased. Rather, just the opposite is ordinarily observed. A more flexible material is often softer, which tends not to provide improved toughness.

Thus, Fock is directed to a different end use than that which is recited in independent Claim 19 -- that is, a method of improving fracture toughness.

It is well settled that in order to be an effective anticipatory reference, a single document must disclose each and every aspect of a claimed invention either explicitly or implicitly. Any feature not directly taught must be inherently present. Failing such precise disclosure, rejections under Section 102 are improper. Here, Fock does not contain a disclosure of each and every element set forth in the claims on appeal.

For instance, Fock does not disclose the improvement of fracture toughness in a curable epoxy-based adhesive composition (rather, the reference speaks to flexibilizing an epoxide resin) or a curable epoxy-based adhesive composition containing a curable epoxy-extended polyacrylate having at least one  $\beta$ -hydroxyester linkage.

Application No. 10/692,935  
Art Unit: 1712

Therefore, as Fock does not disclose each and every aspect of the claims under review, the Section 102(b) rejections based thereon cannot stand and as such Appellants request reversal of the Examiner's rejection by the Board.

2. Rejection of Claims 19-22 and 34 as Unpatentable under 35 U.S.C. Section 103(a) over Fock et al. (U.S. Pat. No. 4,460,746)

As regards the Section 103 rejection based on the Fock reference, epoxy-based adhesive compositions containing the polymers disclosed by Fock are unlikely to have adequate capillary flow for microelectronic assembly applications, such as underfill applications. This is so because the polyacrylate from which the epoxy-extended polyacrylate of the present invention is derived has a number average molecular weight in the range of about 1000 up to about 10,000 and an average functionality of at least about 2.2. The average functionality confers branching to the polyacrylate. The branching translates into a lower viscosity as compared to the viscosity of an analogous unbranched polyacrylate, which means that the polyacrylate is more dispensable or flowable. For a Section 103

obviousness rejection to be proper, the prior art reference or references relied on must teach or suggest all of the claim limitations. Fock neither discloses, teaches or suggests a curable epoxy-extended polyacrylate having at least one  $\beta$ -hydroxyester linkage meeting such requirements, nor would a worker of ordinary skill in the art have found it obvious to modify the polyacrylates described in the Fock reference in order to improve the properties and characteristics of a curable adhesive formulation containing a curable epoxy resin and a curing agent.

Appellants' claimed adhesive compositions, which require the presence of specific curable epoxy-extended polyacrylates having at least one  $\beta$ -hydroxyester linkage, provide both improved fracture toughness and capillary flow properties and are thus distinguished over the compositions of Fock. Appellants' claimed curable adhesive compositions, as a result of the use of particular epoxy-extended polyacrylates, have improved fracture toughness, in terms of a fracture toughness value ( $G_q$ ) when cured exceeding 2 lb/inch (Example 2) and a capillary flow rate through a 2 mil gap between a pair of microscope slides such that the compositions flow 20 cm in not more than 180 seconds at 120 degrees C (Example 3).

The Fock reference proposes that the polymers disclosed therein would be useful in epoxy prepreg formulations. In contrast, the compositions invented by Appellants are utilized as underfill adhesives. Prepregs are molded composites prepared by autoclave or pressclave methods and used as support materials for printed circuits. They provide no adhesive function in the sense of component assembly. There is no similarity in the end use application of epoxy resins for moldings and the adhesive assembly of micro electronic components. Accordingly, a worker of ordinary skill in the art would not have found any suggestion or motivation, either in the Fock reference itself or in the knowledge he or she would possess, to modify the reference to arrive at the subject matter embraced by Appellants' claims.

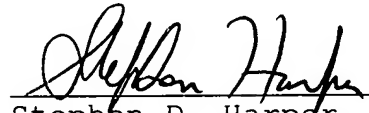
A proper prima facie case of obviousness based on a reference requires that the teaching or suggestion to make the modification in the reference disclosure needed to meet all the limitations of the subject matter recited in a claim must be found in the prior art and cannot be based on the applicant's disclosure. To conclude that the pending claims are obvious over Fock, as the Examiner has, could only have come about from the use of impermissible hindsight. That is, the Examiner must have used the

Application No. 10/692,935

Art Unit: 1712

subject application as a basis for filling in the gaps of the cited reference, since the Fock reference itself, even when read in light of the knowledge generally available to one of ordinary skill in the art, does not teach or suggest all the limitations of the claims currently on appeal in this application. The mere fact that a reference can be modified does not render the resultant modification obvious unless the prior art also suggests the desirability of the modification. *In re Mills*, 916 F.2d 680, 16 USPQ2d 1430 (Fed. Cir. 1990).

Respectfully submitted,

A handwritten signature in dark ink, appearing to read "Stephen Harper", written over a horizontal line.

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**CLAIMS APPENDIX**

1. (Withdrawn) A toughening agent comprising an epoxy-extended polyacrylate, wherein the polyacrylate from which the epoxy-extended polyacrylate is derived has a number average molecular weight in the range of about 1000 up to about 10,000, an average functionality of at least about 2.2, and a polydispersity in the range of about 1.05 up to about 5.

2. (Withdrawn) The toughening agent of claim 1 wherein the functionality of the polyacrylate from which the epoxy-extended polyacrylate is derived is selected from the group consisting of a carboxylic acid, an amine, an anhydride, an hydroxy group, and a phenolic group.

3. (Withdrawn) The toughening agent of claim 1 wherein the epoxy-extended polyacrylate is prepared by reacting a carboxylic acid functionalized polyacrylate with a multi-functional epoxy monomer.

4. (Withdrawn) The toughening agent of claim 3 wherein the carboxylic acid functionalized polyacrylate is selected from poly-functional or branched polymers prepared

by copolymerizing alkyl acrylate(s) with poly-ol polyacrylate(s) in the presence of a chain transfer agent, or from carboxylic acid functionalized branched polyacrylates prepared by polymerization of blends of mono acrylates and divinyl branching agents in the presence of carboxylic acid functionalized chain transfer agents and/or carboxylic acid functionalized initiators.

5. (Withdrawn) The toughening agent of claim 3 wherein the multi-functional epoxy monomer is selected from the group consisting of bisphenol F diglycidyl ether, bisphenol A diglycidyl ether, 4-vinyl-1-cyclohexene diepoxide, butanediol diglycidyl ether, neopentylglycol diglycidyl ether, 3,4-epoxycyclohexylmethyl-3,4-epoxycyclohexanecarboxylate, limonene diepoxide, hexanediol diglycidyl ether, trimethylolpropane triglycidyl ether, aniline diglycidyl ether, diglycidyl ether of propylene glycol, cyanuric acid triglycidyl ether, ortho-phthalic acid diglycidyl ether, diglycidyl ester of linoleic dimer acid, dicyclopentadiene diepoxide, diglycidyl ether of tetrachloro bisphenol A, 1,1,1-tris(p-hydroxyphenyl)ethane glycidyl ether, tetra glycidyl ether of tetrakis(4-hydroxyphenyl)ethane, epoxy phenol novolac resins, epoxy

Application No. 10/692,935  
Art Unit: 1712

cresol novolac resins, and tetraglycidyl-4,4'-  
diaminodiphenylmethane.

6. (Withdrawn) The toughening agent of claim 3 wherein a stoichiometric excess of the multi-functional epoxy monomer is employed in the preparation of the epoxy-extended polyacrylate.

7. (Withdrawn) The toughening agent of claim 6 wherein a sufficient excess of the multi-functional monomer is employed to prevent gelation of the reaction mixture.

8. (Withdrawn) The toughening agent of claim 2 further comprising unreacted multi-functional epoxy monomer.

9. (Withdrawn) The toughening agent of claim 3 further comprising unreacted multi-functional epoxy monomer.

10. (Withdrawn) The toughening agent of claim 1 wherein the epoxy extension is linked to the polyacrylate by a linker selected from the group consisting of:

-Z-, -W-, -Z-W-, -W-Z-, -W-Z-W-,

and combinations of any 2 or more thereof,

wherein:

each Z is independently alkylene, substituted alkylene, cycloalkylene, substituted cycloalkylene, heterocyclic, substituted heterocyclic, oxyalkylene, substituted oxyalkylene, alkenylene, substituted alkenylene, arylene, substituted arylene, alkarylene, substituted alkarylene, aralkylene or substituted aralkylene, and

each W is independently ester, reverse ester, thioester, reverse thioester, amide, reverse amide, silyl, carbonate, or carbamate.

11. (Withdrawn) The toughening agent of claim 1 wherein the polyacrylate from which the epoxy-extended polyacrylate is derived is liquid.

12. (Withdrawn) The toughening agent of claim 1 wherein the epoxy-extended polyacrylate is a liquid.

13. (Withdrawn) The toughening agent of claim 1 wherein the polyacrylate from which the epoxy-extended

polyacrylate is derived has a functionality of at least about 2.5.

14. (Withdrawn) The toughening agent of claim 1 wherein the polyacrylate from which the epoxy-extended polyacrylate is derived has a number average molecular weight in the range of about 1,000 up to 5,000.

15. (Withdrawn) The toughening agent of claim 1 wherein the polyacrylate from which the epoxy-extended polyacrylate is derived has a branched structure.

16. (Withdrawn) The toughening agent of claim 1 wherein the principle repeat unit of the polyacrylate from which the epoxy-extended polyacrylate is derived is selected from the group consisting of n-butyl acrylate, 2-ethylhexyl acrylate, and isooctyl acrylate.

17. (Withdrawn) The toughening agent of claim 1 wherein the viscosity of the epoxy-extended polyacrylate falls in the range of about 5-500 Pascal-seconds at 25°C.

18. (Withdrawn) The toughening agent of claim 1 wherein the viscosity of the epoxy-extended polyacrylate falls in the range of about 20-200 Pascal-seconds at 25°C.

19. (On Appeal) A method to improve the fracture toughness of a curable epoxy-based adhesive composition, the method comprising adding to the adhesive composition an effective amount of a curable epoxy-extended polyacrylate having at least one  $\beta$ -hydroxyester linkage, wherein the polyacrylate from which the epoxy-extended polyacrylate is derived has a number average molecular weight in the range of about 1000 up to about 10,000, an average functionality of at least about 2.2, and the functionality of the polyacrylate from which the epoxy-extended polyacrylate is derived is a carboxylic acid.

20. (On Appeal) A curable adhesive formulation comprising:

a curable epoxy resin,

a curing agent,

a curable epoxy-extended polyacrylate having at least one  $\beta$ -hydroxyester linkage, wherein the polyacrylate from which the epoxy-extended polyacrylate is derived has a number average molecular weight in the range of about 1000

Application No. 10/692,935  
Art Unit: 1712

up to about 10,000, an average functionality of at least about 2.2, and the functionality of the polyacrylate from which the epoxy-extended polyacrylate is derived is a carboxylic acid; and

optionally, a filler.

21. (On Appeal) The adhesive formulation of claim 20 wherein the formulation contains substantially no latent curing agent; and the cure onset temperature of the curable epoxy resin is less than about 220°C.

22. (On Appeal) The adhesive formulation of claim 20 wherein said curing agent is selected from the group consisting of anhydrides, amines, imidazoles, amides, thiols, carboxylic acids, phenols, dicyandiamide, urea, hydrazine, hydrazide, amino-formaldehyde resins, melamine-formaldehyde resins, amine-boron trihalide complexes, quaternary ammonium salts, quaternary phosphonium salts, tri-aryl sulfonium salts, di-aryl iodonium salts, diazonium salts, and combinations of any two or more thereof.

23. (Withdrawn) A method for adhesively attaching a device to a substrate, the method comprising dispensing an adhesive formulation according to claim 10 onto a substrate

Application No. 10/692,935  
Art Unit: 1712

and/or a device or between the substrate and the device to form an assembly, and exposing the assembly to conditions sufficient to cure the adhesive.

24. (Withdrawn) An assembly produced by the method of claim 23.

25. (Withdrawn) A method for adhesively attaching a first article to a second article, the method comprising:

(a) applying a formulation according to claim 10 to the first article,

(b) bringing the first article and the second article into intimate contact to form an assembly wherein the first article and the second article are separated only by the adhesive formulation applied in step (a), and thereafter,

(c) subjecting the assembly to conditions suitable to cure the adhesive formulation.

26. (Withdrawn) An assembly produced by the method of claim 25.

27. (Withdrawn) A method for encapsulating an electronic component, the method comprising:

Application No. 10/692,935  
Art Unit: 1712

applying a formulation according to claim 10 to the component, and

curing the formulation.

28. (Withdrawn) An article prepared according to the method of claim 27.

29. (Withdrawn) A method for encapsulating an electronic component, the method comprising curing a formulation according to claim 10 after application of the composition to the component.

30. (Withdrawn) An article prepared according to the method of claim 29.

31. (Withdrawn) An article comprising an electronic component adhesively attached to a circuit board, wherein the electronic component is adhesively attached to the board by a cured aliquot of a formulation according to claim 10.

32. (Withdrawn) A cured aliquot of a formulation according to claim 10.

33. (Withdrawn) A method for preparing a toughening agent comprising an epoxy-extended polyacrylate, wherein the polyacrylate from which the epoxy-extended polyacrylate is derived has a number average molecular weight in the range of about 1000 up to about 10,000, an average functionality of at least about 2.2, and a polydispersity in the range of about 1.05 up to about 5, the method comprising subjecting a neat mixture of the polyacrylate and a multi-functional epoxy monomer to a temperature in the range of about 100 up to about 150°C for a time in the range of about 1 up to about 24 hours in the substantial absence of a catalyst.

34. (On Appeal) The adhesive formulation of claim 20 wherein said epoxy-extended polyacrylate is prepared by reacting a carboxylic acid functionalized polyacrylate with a multi-functional epoxy monomer.

Application No. 10/692,935  
Art Unit: 1712

**EVIDENCE APPENDIX**

None.

Application No. 10/692,935  
Art Unit: 1712

**RELATED PROCEEDINGS APPENDIX**

None.